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(54) **PRESSURE BAG**

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CPC ***B41J 2/17506*** (2013.01); *Y10T 29/49401* (2015.01); ***B41J 2/17513*** (2013.01); *B41J 2002/17516* (2013.01); ***B41J 2/17559*** (2013.01)

(58) **Field of Classification Search**
CPC B41J 2/17513; B41J 2002/17516; B41J 2/17503; B41J 2/17559; B41J 2/17506
USPC 347/84, 85, 86
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,917,523	A	6/1999	Baldwin et al.	
5,975,686	A	11/1999	Hauck et al.	
6,050,682	A	4/2000	Pawlowski, Jr.	
6,213,598	B1	4/2001	Hou et al.	
6,220,702	B1	4/2001	Nakamura et al.	
6,739,710	B2	5/2004	Lin et al.	
6,866,374	B2	3/2005	Taku	
6,874,873	B2	4/2005	Thielman et al.	
7,093,710	B2	8/2006	Shimizu et al.	
7,556,365	B2	7/2009	Stathem	
7,618,135	B2	11/2009	Stathem et al.	
2002/0047883	A1	4/2002	Hou et al.	
2003/0122908	A1	7/2003	Lin	
2003/0142180	A1 *	7/2003	Gonzales	347/86
2007/0222829	A1	9/2007	Stathem	

FOREIGN PATENT DOCUMENTS

EP	0633137	A2	1/1995
EP	1093922	A1	4/2001
EP	1541358	A2	6/2005
TW	520709		2/2003
TW	I221123		9/2004

* cited by examiner

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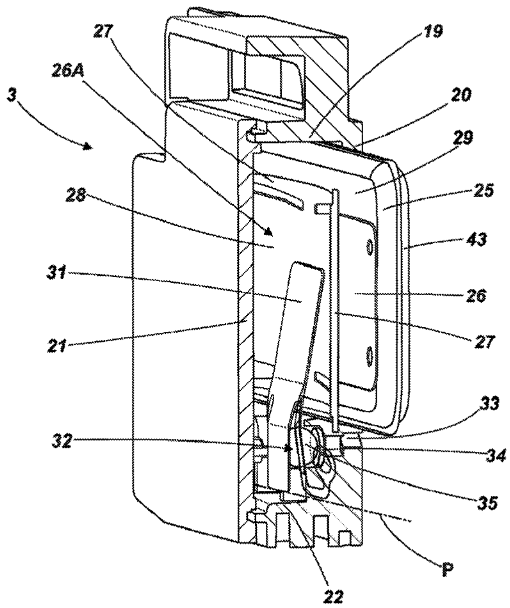
(57) **ABSTRACT**

A pressure bag for in a fluid cartridge having an opening in open connection with a channel in a wall of the fluid cartridge.

20 Claims, 11 Drawing Sheets



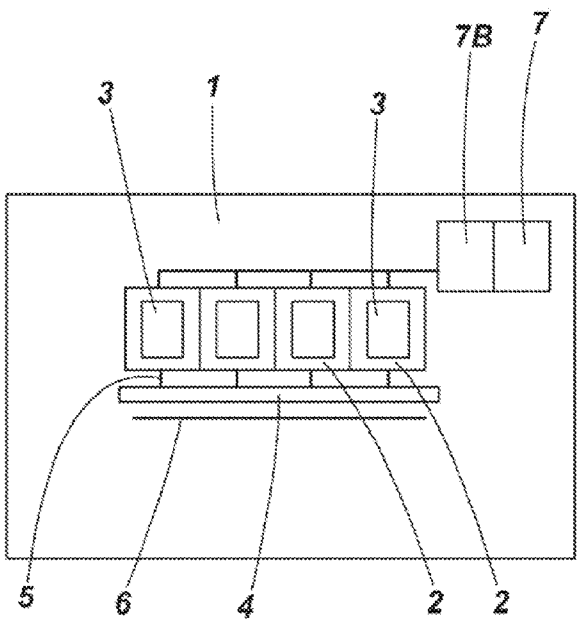


Fig. 1

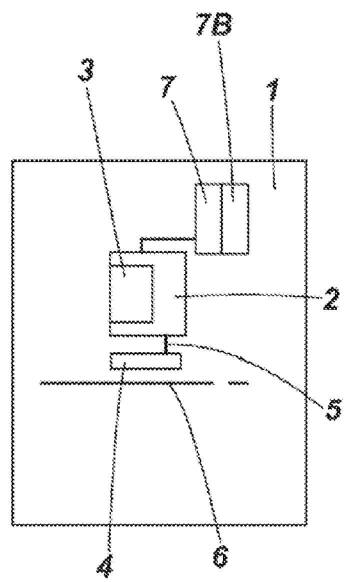


Fig. 2

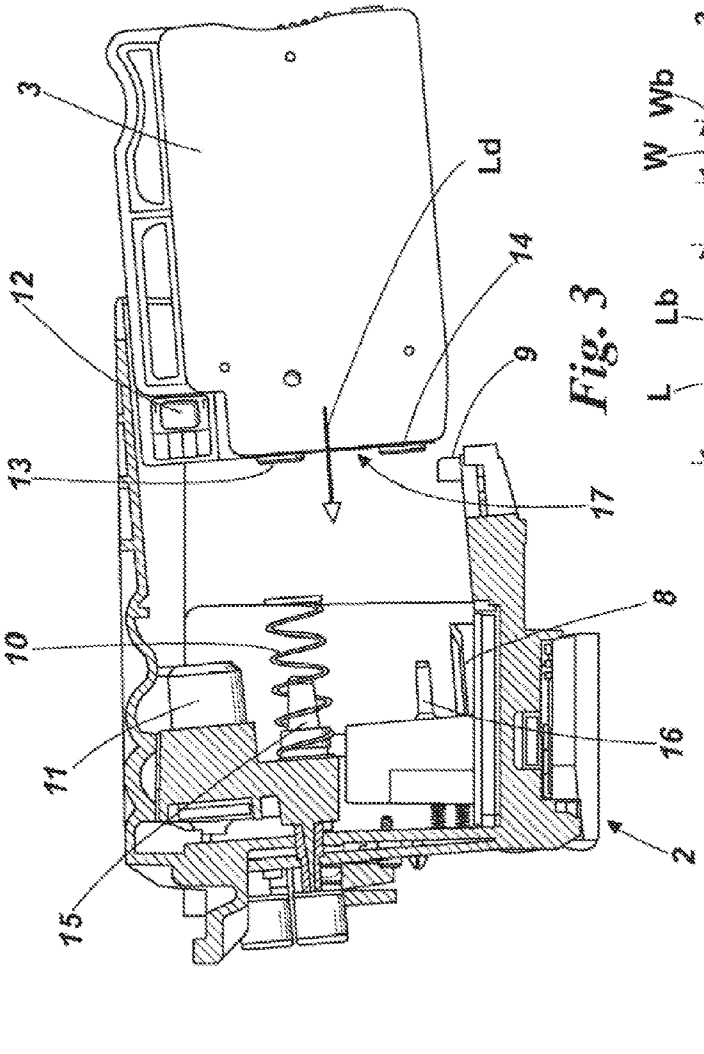


Fig. 3

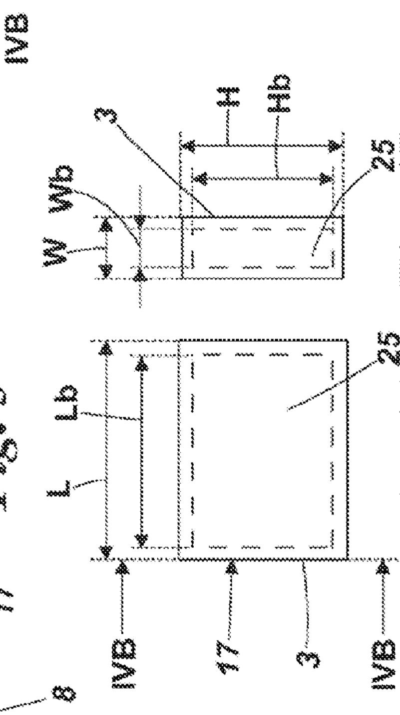


Fig. 4A

Fig. 4B

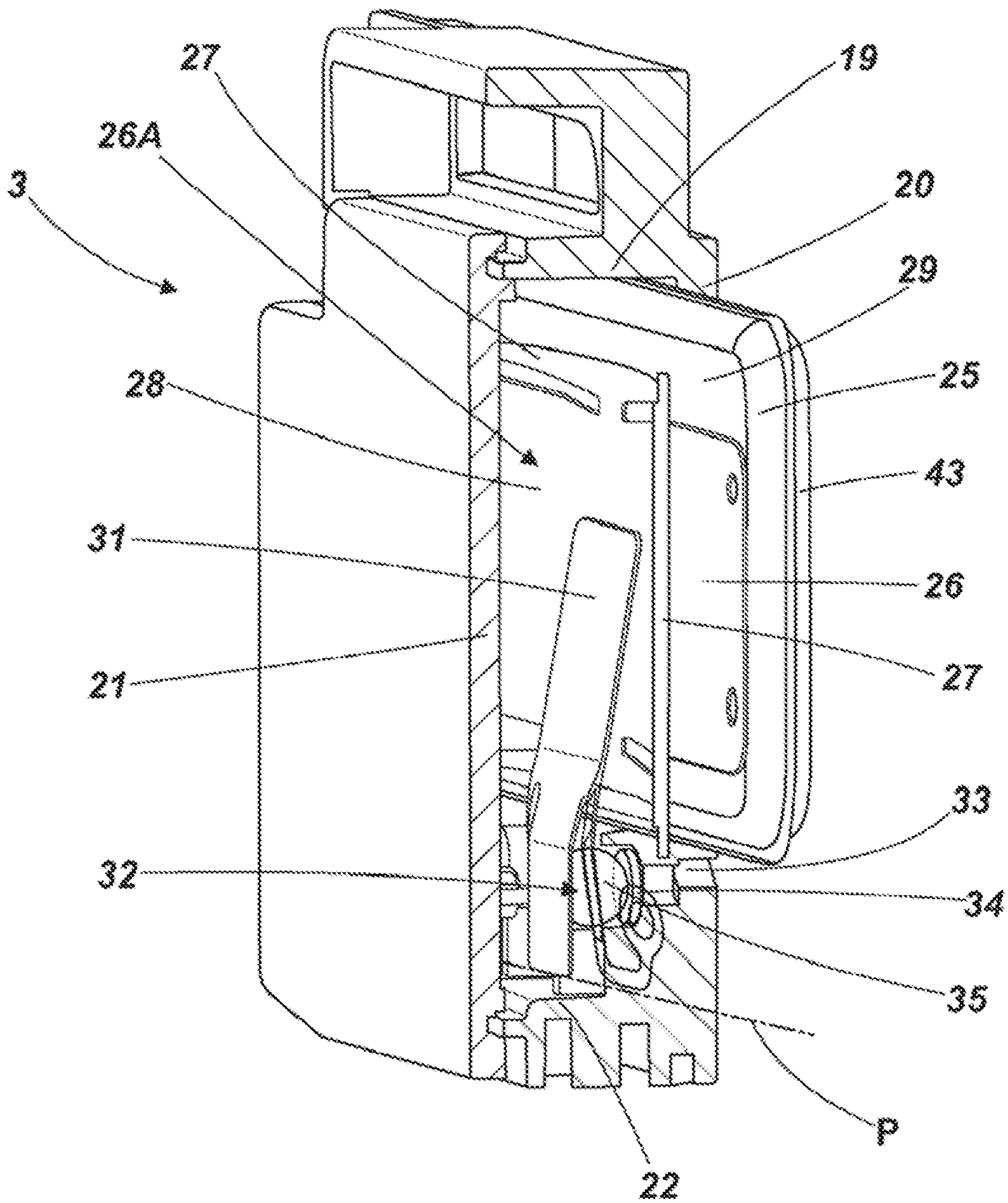


Fig. 5

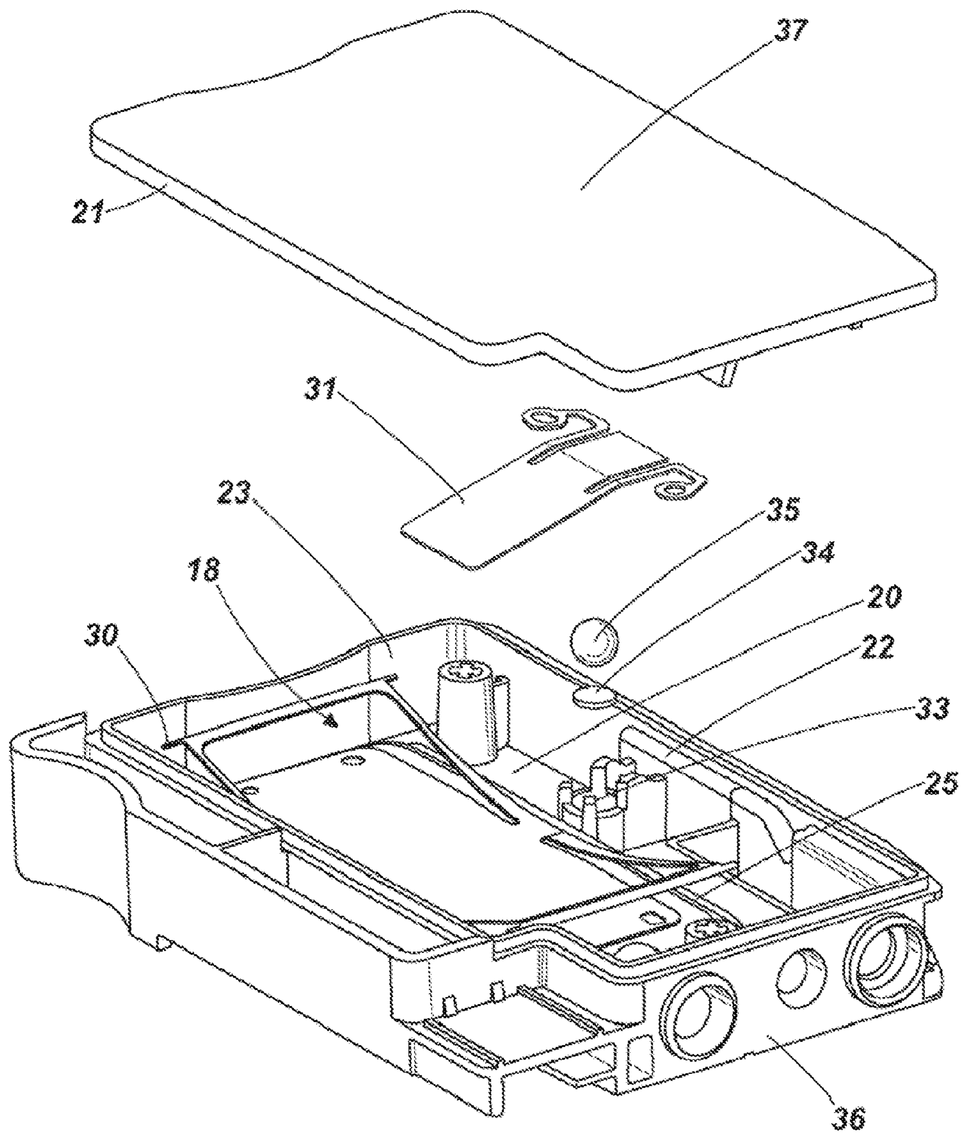


Fig. 6

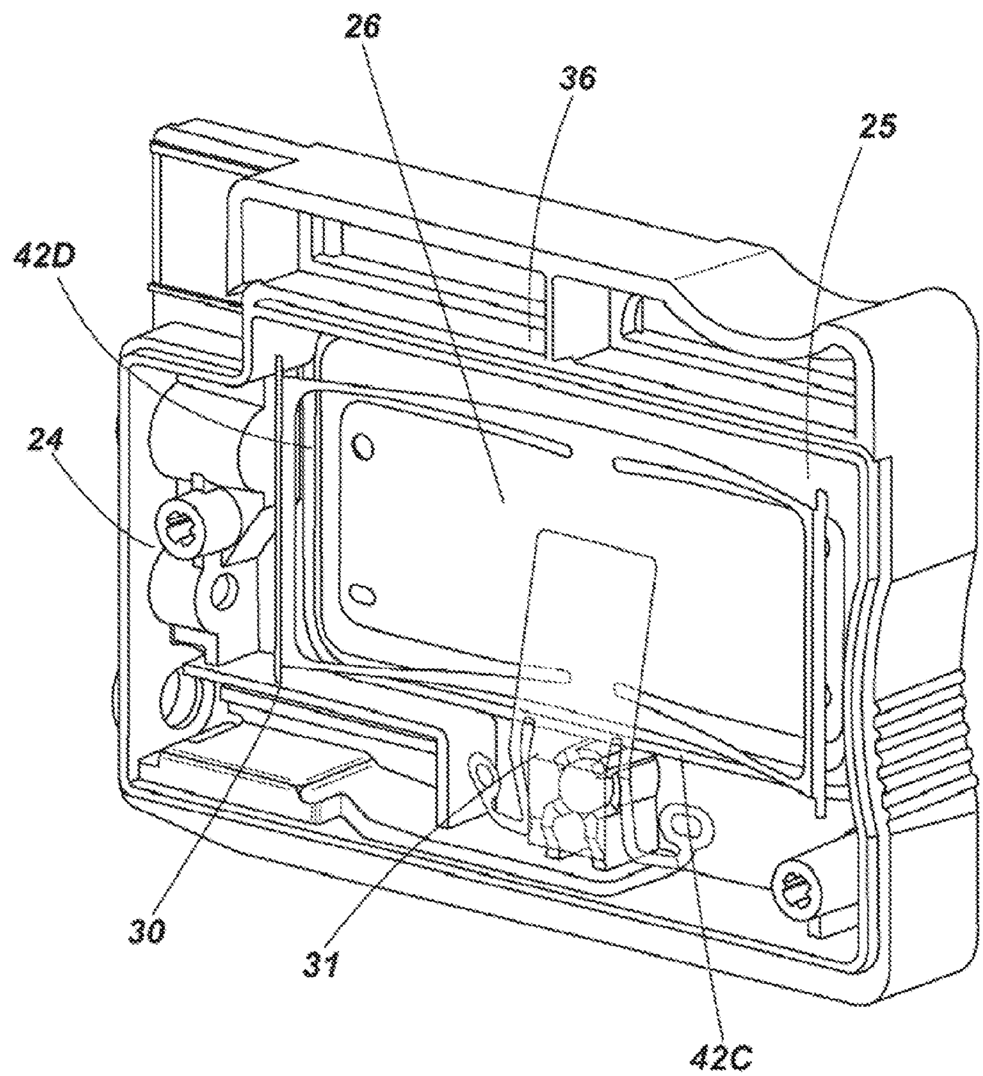


Fig. 7

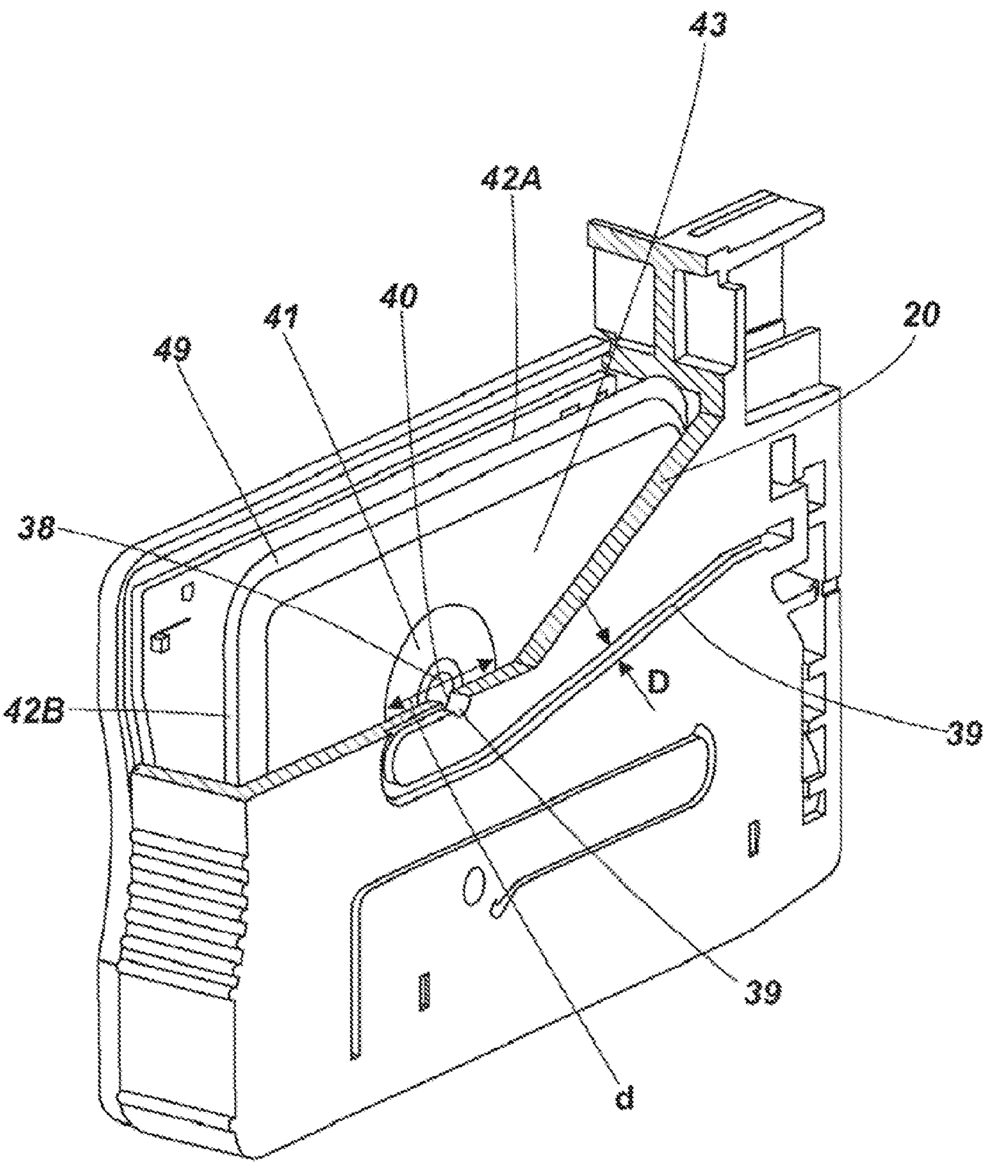


Fig. 8

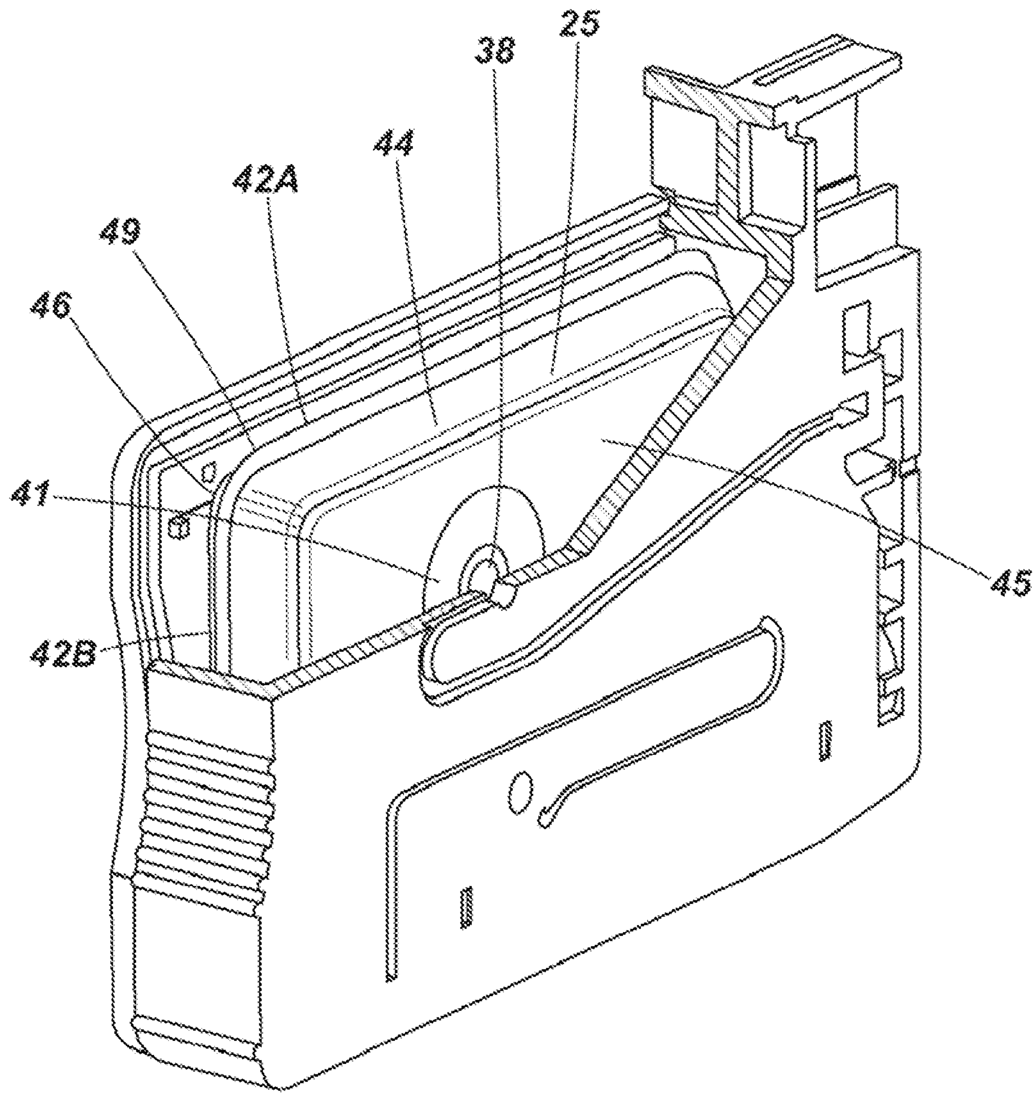


Fig. 9

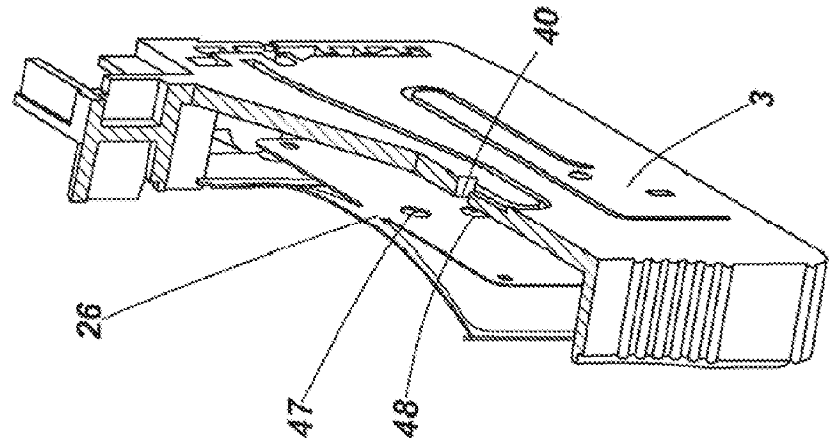


Fig. 10B

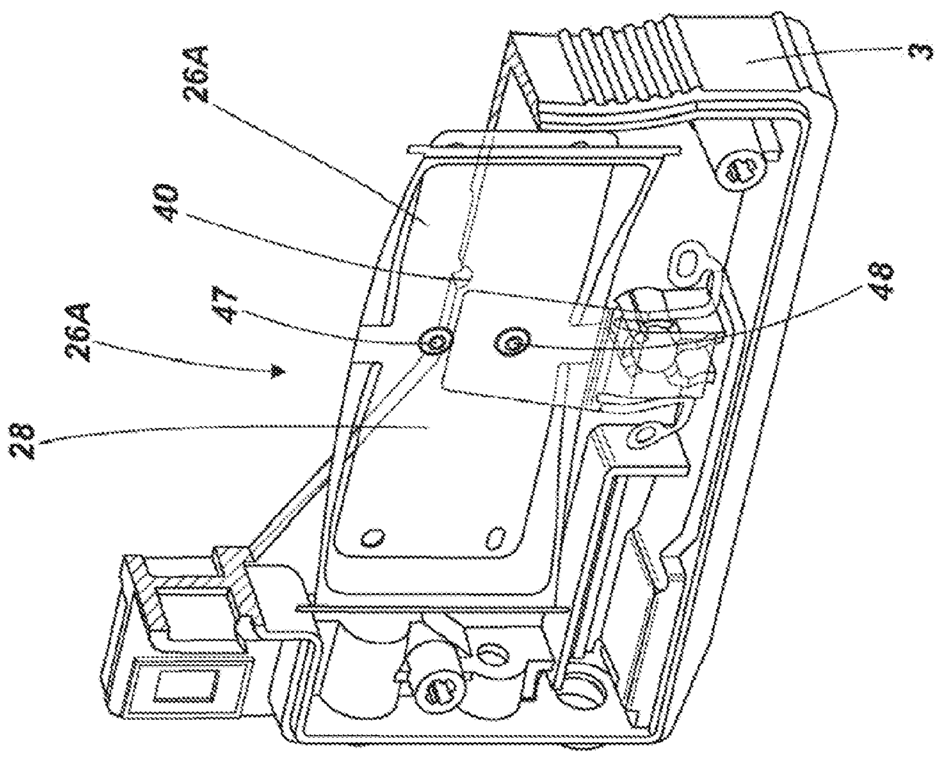


Fig. 10A

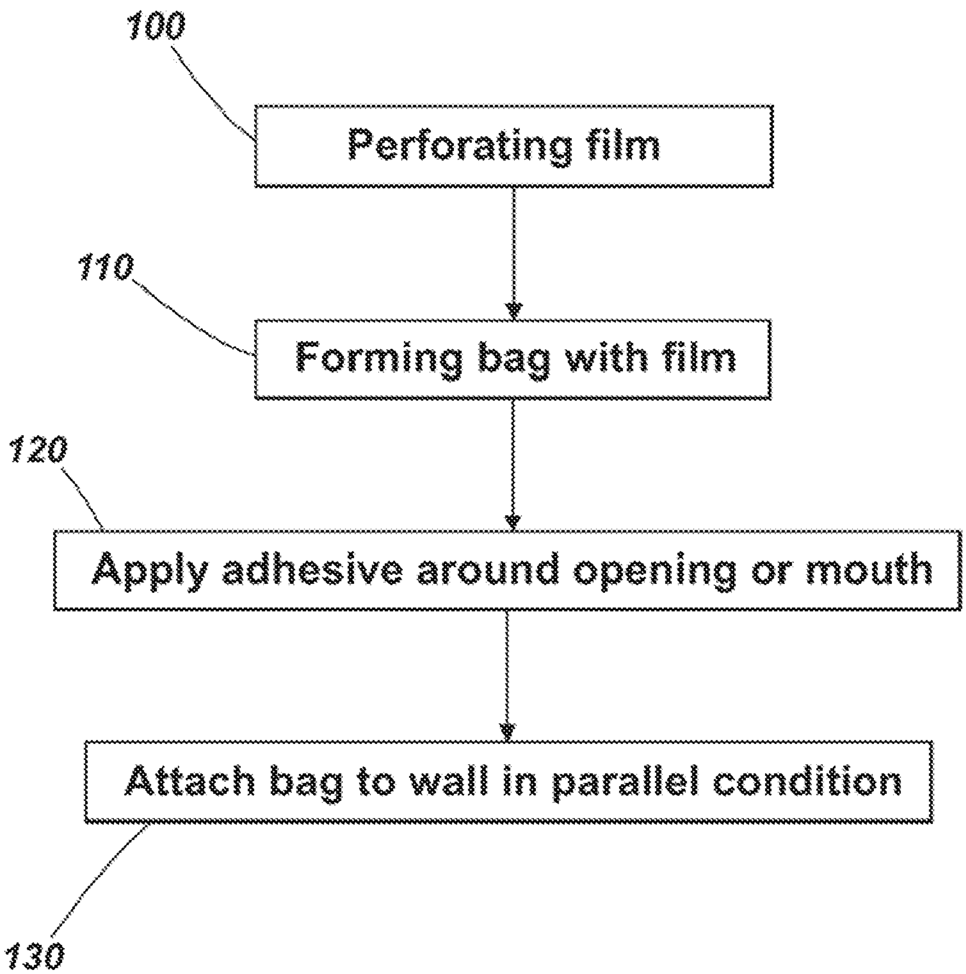

100
Perforating film
110
Forming bag with film
120
Apply adhesive around opening or mouth
Attach bag to wall in parallel condition
130

Fig. 11

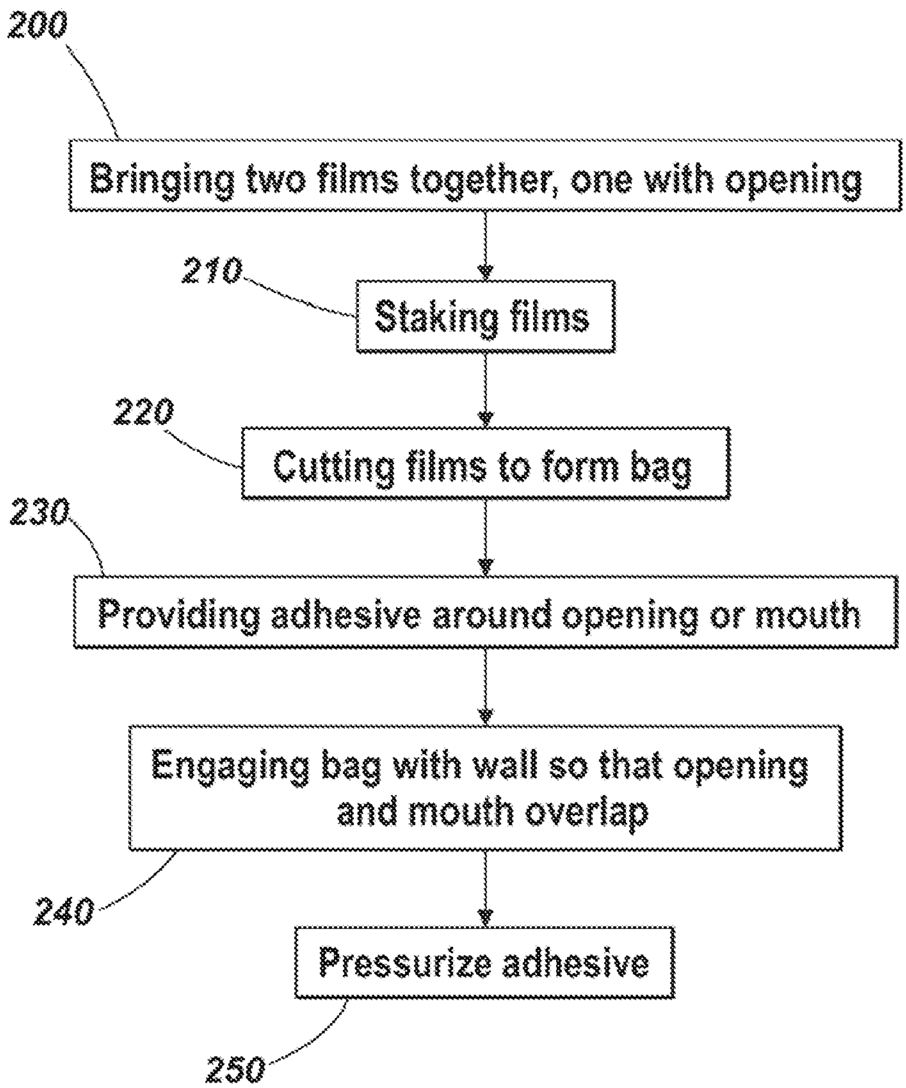

200
Bringing two films together, one with opening
210
Staking films
220
Cutting films to form bag
230
Providing adhesive around opening or mouth
Engaging bag with wall so that opening and mouth overlap
240
Pressurize adhesive
250

Fig. 12

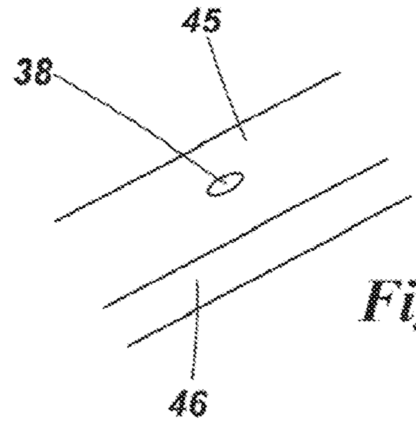


Fig. 13A

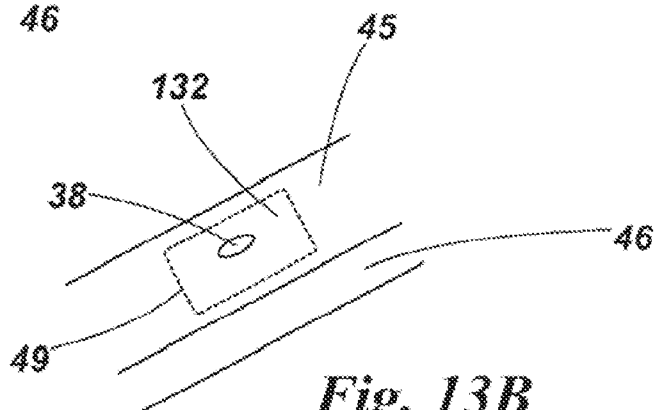


Fig. 13B

Fig. 13C

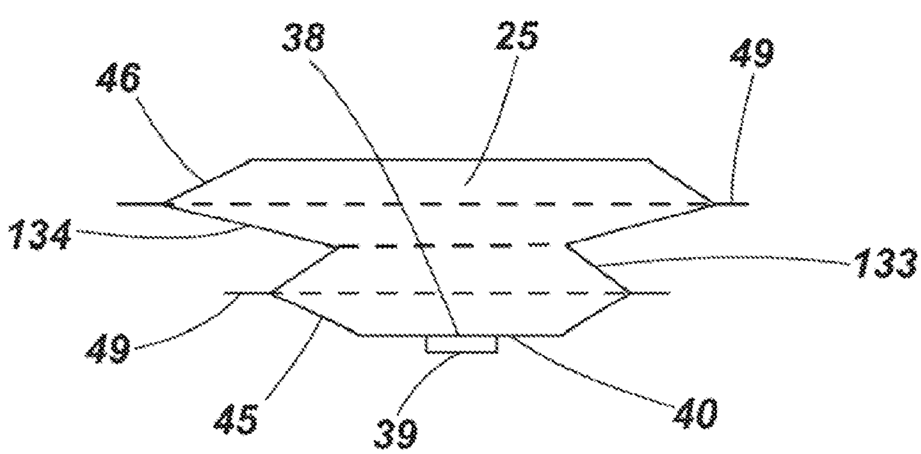


Fig. 14

PRESSURE BAG

BACKGROUND OF THE INVENTION

In printers, print heads are provided to fire droplets of ink onto print media. The fluid is provided in a cartridge. The cartridge may be separately provided from the print head, or may be integrated with the print head. In many cases, the cartridge is a consumable supply that can be exchanged with respect to the printer. In some cases, the cartridge is arranged to be refilled, for example while being mounted in the printer.

The pressure in the cartridge needs to be carefully controlled well because it has an effect on the fluid flow into and/or out of the print head. In turn, this may have an effect on fluid drop characteristics, which is one of the most important parameters of image quality.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of illustration, certain embodiments of the present invention will now be described with reference to the accompanying diagrammatic drawings, in which:

FIG. **1** shows a diagram of an embodiment of a printer with cartridges mounted therein in front view;

FIG. **2** shows a diagram of the embodiment of the printer of FIG. **1** in side view;

FIG. **3** shows an embodiment of a cartridge and a cartridge receiver in cross sectional side view;

FIGS. **4**A and **4**B diagrammatically illustrate the contours of an embodiment of a cartridge, in side view and in front view, respectively;

FIG. **5** shows a perspective, partly cross sectional view of an embodiment of a cartridge;

FIG. **6** shows an exploded view of an embodiment of the cartridge of FIG. **5**;

FIG. **7** shows a perspective, cross sectional view of the embodiment of a cartridge of FIGS. **5** and **6**;

FIG. **8** shows a perspective, partly cross sectional view of the embodiment of a cartridge of FIGS. **5-7**, wherein the bag is in a substantially deflated condition;

FIG. **9** shows a perspective, partly cross sectional view of the embodiment of a cartridge of FIGS. **5-8**, wherein the bag is in a substantially inflated condition;

FIG. **10**A shows a perspective, cross sectional view, of an embodiment of a cartridge including a leaf spring with depressions, wherein the spring is made transparent and the bag is left out for illustrative reasons;

FIG. **10**B shows a perspective, cross sectional view, of the embodiment of FIG. **10**A from a different viewpoint;

FIG. **11** shows a flow chart of an embodiment of a part of a method of manufacturing a cartridge;

FIG. **12** shows a flow chart of a further embodiment of a part of a method of manufacturing a cartridge;

FIG. **13**A-C diagrammatically visualize three phases the method of manufacturing a cartridge pressure bag, corresponding to FIG. **12**;

FIG. **14** shows a diagrammatic cross sectional front view of an embodiment of a pressure bag and opening.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings. The embodiments in the description and drawings should be considered illustrative and are not to be considered as limiting to the specific embodiment of element described. Multiple embodiments may be derived from the following description and/or drawings through modification, combination or variation of certain elements. Furthermore, it may be understood that also embodiments or elements that are not literally disclosed may be derived from the description and drawings by a person skilled in the art.

In most cartridges a certain back pressure is present in its inner volume to control the fluid flow. “Backpressure” may be understood as a pressure that is lower than the atmospheric pressure, which inhibits fluid from leaking out of the cartridge. If the cartridge lacks sufficient back pressure, ink may leak from the print head. On the other hand, if the backpressure is excessive, the nozzles may not fire properly. The back pressure is carefully controlled by a back pressure controlling mechanism present in the cartridge.

A known type of cartridge uses a porous member that is mounted in the fluid volume to absorb the fluid. Here, a back pressure effect is obtained by the capillary characteristics of the porous member. One disadvantage of this arrangement is that the porous member consumes space within the volume of the cartridge.

Another arrangement for controlling pressure and back pressure within a cartridge, and that tends to consume less space than a porous member, is an arrangement of a pressure bag and bias spring. The cartridge and the bag have an opening in its walls for permitting ventilation between the bag and an exterior of the cartridge. For example, this allows atmospheric air to enter into the bag. The bag is arranged to inflate or deflate within the cartridge in response to a pressure change inside or outside of the cartridge. When the bag is inflated in the cartridge, the bias spring presses against the bag to partly deflate the bag, which causes a small amount of back pressure. The bag construction is also used for priming the printer, wherein the bag is actively hyperinflated and deflated causing rapid pressurization for priming.

FIGS. **1** and **2** show an embodiment of a fluid ejection device **1**. The fluid ejection device **1** may comprise a printer. The printer may be an inkjet printer, for example a thermal inkjet, a piezo inkjet, or a continuous inkjet printer. The fluid ejection device **1** comprises one or more receiving structures **2** for receiving and exchanging fluid cartridges **3**. In the shown embodiment, the fluid ejection device **1** comprises multiple receiving structures **2** for receiving multiple respective cartridges **3**. Each cartridge **3** may comprise a different fluid. In the shown embodiment each cartridge **3** comprises a specific ink color, for example a cyan, magenta, yellow, black and/or grey. The cartridges **3** are arranged to be exchanged with respect to the receiving structure **2**.

The cartridge **3** comprises an inner volume **18** for holding fluid. The inner volume **18** is defined by cartridge walls **19-24** (FIGS. **5-7**). The receiving structures **2** are arranged to connect the cartridge **3** to the print head **4**. A fluid supply **5** is provided to receive fluid from the respective cartridges **3**, and deliver the fluid to the print head **4**.

The receiving structure **3** is arranged to establish a fluidic interface between the cartridge **3** and the fluid supply **5**. The receiving structures **2** may be arranged off axis and/or on axis. The print head **4** may comprise a scanning print head **4** or a page wide array print head **4** (PWA). In the shown embodiment, the fluid ejection device **1** comprises an off axis system with a PWA, wherein the receiving structure **2** and the cartridges **3**, when installed, have a fixed position with respect to the fluid ejection device **1**. During printing a print medium **6** extends under the print head **4**.

The fluid ejection device **1** is further provided with a control circuit **7** and a memory **7**B. The receiving structure **2** and the cartridge **3** may comprise an electrical interface for connecting the respective cartridge **3** to the control circuit **7**.

FIG. **3** shows an arrangement of a receiving structure **2** and a fluid cartridge **3**. The receiving structure **2** is part of a printer (not shown). In the shown embodiment, the receiving structure **2** and the cartridge **3** comprise multiple interconnecting interfaces.

A mechanical interface is provided for connecting the cartridge **3** to the receiving structure **2**, so that the fluidic and electrical interfaces are connected. The mechanical interface may be arranged to allow lateral insertion of the cartridge **3**, in a lateral direction Ld, so that the fluidic and electrical interfaces on the front face **17** of the cartridge **3** connect to corresponding interfaces of the receiving structure **2**. For example, the receiving structure **2** may comprise a guide **8** for guiding the cartridge **3** into the receiving structure **2**. The cartridge **3** may comprise a corresponding slide arrangement in its bottom (not visible in figures). In the shown embodiment the guide **8** comprises a T-rail. The receiving structure **2** may comprise a latch **9** for locking the cartridge **3** to the receiving structure **2**, by engaging a corresponding notch (not shown) in the cartridge **3**. A release mechanism **10** may be provided, for releasing and/or pushing out the cartridge **3** when the latch **9** is unlocked. Furthermore, the receiving structure **2** may comprise an electrical interface **11**, of which only the backside is shown In FIG. **3**, for connection to a cartridge electrical interface **12**, for establishing an electrical connection between the cartridge **3** and the control circuit **7**.

The fluid cartridge **3** is provided with two fluidic interfaces **13**, **14** for connection with two corresponding fluidic interfaces **15**, **16** of the receiving structure **2**. As shown in FIG. **3**, the cartridge fluidic interfaces **13**, **14** may be arranged on the front face **17**. A first cartridge fluidic interface **13** is adapted to allow a first fluid to flow through. The first cartridge fluidic interface **13** is arranged to mate with a corresponding first receiving fluidic interface **15** of the receiving structure **2**. These first fluidic interfaces **13**,**15** fluid tightly interconnect for guiding a first fluid into and/or out of the cartridge **3**. A second cartridge fluidic interface **14** is arranged to mate with a corresponding second receiving fluidic interface **16**. The second interfaces **14**, **16** are arranged to guide a second fluid into and/or out of the cartridge **3**. In an embodiment, the first fluid comprises a pressure fluid and the second fluid comprises a liquid, for example ink. The pressure fluid may comprise gas, for example ambient air. In use, the pressure fluid inflates and deflates a pressure bag in the cartridge **3**, for controlling a pressure of the second fluid in the inner volume **18** of the cartridge **3**.

As can be seen from FIGS. **4**A and B, the fluid cartridge **3** may have a relatively thin shape. The thin shape may be realized by the synergetic design of the interfaces, including the mechanical interface, and the interior mechanisms of the cartridge **3**, which will be explained into further detail below. For example, the fluid cartridge **3** may have a length L versus width W ratio of at least approximately 4:1, or at least approximately 5:1, or at least approximately 6:1, respectively. In an embodiment the length L is approximately 72.5 millimeter and the width W is approximately 13.5 millimeter. In other words, the width W of the cartridge **3** may be at least approximately four times less than the length L of the cartridge **3**, or at least approximately five times or six times less than the length L of the cartridge **3**. In this disclosure, the length L, width W and height H of the cartridge **3** are measured according to the outer contours of the cartridge **3**, as can be seen from FIGS. **4**A and **4**B. The length L, width W and height H are measured along directions that are perpendicular to each other, like a 3 dimensional axes system. In a further embodiment, a height H versus width W ratio may be at least approximately 3:1, respectively. For example the height H is approximately 42 millimeter while the width W is approximately 13.5 millimeter. A thin cartridge **3** may save space in the fluid ejection device **1**, have less material costs, and/or may ultimately also lead to a relatively smaller and/or flatter fluid ejection device **1**. A thin cartridge **3** may be easier to hold by hand and to manually connect to the receiving structure **2**.

FIG. **5** shows a cross section of an embodiment of a cartridge **3** in perspective view. The cartridge's inner volume **18** is shown. The inner volume **18** is defined by cartridge walls **19-24** (FIGS. **5-7**). A second fluid is contained in the inner volume **18**. A first fluid is contained in a pressure bag **25**, when the pressure bag **25** is at least partially inflated. In this embodiment the first fluid is a pressure fluid and the second fluid comprises ejection fluid such as ink.

The pressure bag **25** has a fluidic connection with the first cartridge fluidic interface **13**. In an installed position of the cartridge **3**, the pressure fluid such as air is guided through the first cartridge fluidic interface **13** into and out of the bag **25**. A channel **39** (FIG. **8**) may connect the bag **25** to the first cartridge fluidic interface **13**. In certain embodiments, the channel **39** may connect directly to an exterior of the cartridge **3**. In this embodiment, the exterior comprises ambient air.

In an inflated condition, the bag **25** may have a relatively small width Wb, following the thin shaped inner volume **18** of the cartridge **3**, as diagrammatically illustrated in dashed lines in FIGS. **4**A and **4**B. The length Lb or height Hb of the bag **25** versus the width Wb of the bag **25** may be at least approximately 3:1, or at least approximately 4:1, or at least approximately 5:1, respectively, in a maximally inflated condition within the cartridge **3**.

The bag **25** is arranged to maintain a certain approximate back pressure in the inner volume **18**. In an embodiment, the bag **25** functions as a part of a pressure accumulator arrangement that prevents that the back pressure becomes too low, preventing dripping of fluid out of the cartridge **3** and/or print head nozzles. As a part of a pressure accumulator, the bag **25** reacts to changes in pressure, for example due to changes in temperature and/or pressure outside and/or inside of the cartridge **3**, for example by letting air out of the bag **25** when the cartridge inner pressure increases relative to an outer pressure. In a further embodiment, the bag **25** may function as a part of a pressure regulation arrangement by preventing a back pressure from becoming too high, which may be caused by fluid ejecting out of the cartridge **3** and/or changes in temperature and/or pressure. The pressure regulator arrangement may allow fluid, such as air and/or ink, to enter in the inner volume **18** of the cartridge **3**. Furthermore, the bag **25** may function as a part of a priming arrangement, by being arranged to hyper-inflate, in that way rapidly increasing an inner pressure of the cartridge **3**. As a part of a priming arrangement, the bag **25** may be connected to a pump (not shown), for example through the first fluid interfaces **13**, **15**. In an embodiment, the cartridge **3** comprises a pressure regulation, a pressure accumulation and a priming arrangement. An embodiment wherein the bag **25** functions as a part of an integrated pressure regulation, pressure accumulation and priming arrangement is explained below.

In an embodiment, the integrated pressure accumulator, pressure regulator and priming arrangement comprises a bag **25**, a resilient element **26**A, a lever **31** and a valve **32**. The cartridge **3** may comprise a resilient element **26**A in its volume to provide a resilient force against the bag **25**. In use, the bag **25** may suck in pressure fluid to compensate for a decrease in pressure. For example, the bag **25** would inflate by ambient air until the pressure in the bag **25** is approximately the same as the ambient air at the cartridge exterior. The resilient element **26**A prevents the bag **25** from expanding too far by pushing against the bag **25**. The resilient element **26**A thereby maintains a certain backpressure in the inner volume **18**. Such mechanism may prevent leaking of the nozzles. The resilient element **26**A and the bag **25** are adapted to maintain the back pressure at a suitable level, providing for a pressure accumulation arrangement.

In the shown embodiment, the resilient element **26**A comprises a leaf spring **26**. The leaf spring **26** may be relatively flat. The leaf spring **26** may be arranged between and/or against a side wall **21** of the cartridge **3** and the bag **25**. The leaf spring **26** may comprise at least one or at least two bias legs **27** that bias the spring **26** towards the bag **25**. The spring **26** may comprise an engagement surface **28** for engaging the bag. **25**. In the shown embodiment, the spring **26** comprises two opposite pre-biased curved legs **27** that are arranged around the outer contour of the engagement surface **28** of the spring **26**. The legs **27** may be curved in a surface perpendicular to said side wall **21**, to bias the spring **26** away from the side wall **21**. The curves in the legs **27** are adapted so that the leaf spring **26** exerts a relatively constant force against the bag **25** relatively independent of the depression of the spring **26**. The engagement surface **28** may have a relatively large surface for engaging a relatively large portion of one of the two surfaces **29**, **43** of the bag **25**. For example at least 40% of the surface **29** of the bag **25** may engage the engagement surface **28** of the spring **26**, at least in an at least partially deflated condition of the bag **25**. For example, in the embodiment shown in FIG. **5** the engagement surface **28** engages at least approximately 50% of the surface **29** of the bag **25**. The engagement surface **28** engages the surface **29** of the bag **25** without being attached to the bag **25**. This may provide for relatively easy assembly of the spring **26** and the bag **25** in the cartridge **3**. The bias legs **27** are attached to said engagement surface **28**. In other embodiments, instead of a leaf spring **26**A with curved legs **27**, the resilient element **26**A may include other types of legs or resilient members attached to an engagement surface **28** for providing a resilient force against the bag **25**.

A further feature of the leaf spring **26** may include at least one gripping extension **30** for gripping and assembling the leaf spring **26**. In the shown embodiment, the spring **26** comprises four gripping extensions **30**, one at each outer corner of the respective legs **27**. During assembly, at least one gripping extensions **30** may be attached to the lid, and placed inside the cartridge **3**, against the bag **25**, as is shown in FIG. **6**. The extensions **30** provide make a more efficient assembly of the cartridge **3** possible. The gripping extensions **30** may comprise protrusions or pins.

In the shown embodiment, a lever **31** is provided that may pivot approximately around a pivot axis P. The lever **31** may engage a valve **32** that seals a third fluidic interface **33**. The valve **32** may comprise a rubber disk **34** that closes off the third fluidic interface **33** and a contact ball **35** between the lever **31** and the disk **34**. The third fluidic interface **33** may be connected to an air and/or ink supply, for allowing further air and/or ink to stream into the inner volume **18**. In one embodiment, the fluid ejection device **1** comprises on and/or off axis fluid cartridges, and in use, ink may be provided through the third fluidic interface **33**. In another embodiment, the fluid ejection device **1** comprises on and/or off axis fluid cartridges, and in use, air may be provided through the third fluidic interface **33**.

The lever **31** is moved by inflating or deflating the bag **25**. In a deflated condition of the bag **25**, the lever **31** may push against the valve **32** so as to seal the third fluidic interface **33**. In an inflated condition of the bag **25**, the lever **31** may release the valve **32** with respect to the third fluidic interface **33** because the bag **25** moves the lever **31** away from the third fluidic interface **33**. Here, the valve **32** may acts as a pressure regulator and/or a check valve. In the shown embodiment the lever **31** engages the engagement surface **28** of the spring **26**. Inflation or deflation of the bag **25** moves the spring **26**, which in turn moves the lever **31**. For example, when a back pressure inside the cartridge **3** increases during printing, the bag **25** Inflates, causing the lever **31** to release the valve **32**, allowing for air and/or ink to enter into the inner volume **18**, thereby again increasing the inner pressure and deflating the bag **25** until a certain equilibrium is achieved, which in this embodiment may be a slight back pressure as explained earlier.

In a further embodiment, the bag **25** functions as part of a priming arrangement. The bag **25** may be hyper-inflated for priming, causing a rapid increase of pressure in the inner volume **18** because of the relatively large expansion of the bag **25**. The hyperinflation causes air and/or ink to be let out through the respective fluidic interface **16** and/or the print head nozzles. During this priming action, the valve **32** may function as a check valve. Priming may be activated through the first fluidic interfaces **13**, **15**, that are connected to a pressure fluid supply and/or a pump. The priming action may be activated through the control circuit **7** of the fluid ejection device **1**.

In the embodiment described above, the bag **25** actuates a valve **32** through a resilient element **26**A and a lever **31**, however, in other embodiments the valve **32** may be actuated directly by the bag **25**, or directly through one of the resilient element **26**A or lever **31**, or through other arrangements.

FIGS. **6** and **7** illustrate further perspective views of the embodiment of FIG. **5**. FIGS. **6** and **7** are illustrative for the ease of assembly of the cartridge **3**. For example, the cartridge **3** may comprise two shells **36**, **37** that when connected enclose the inner volume **18**. The shells **36**, **37** may comprise molded plastic. The shells **36**, **37** may be injection molded. A first shell **36** may comprise the fluidic interfaces **13**, **14** and the fluid throughput **33**. The first shell **36** may comprise five **19**, **20**, **22**, **23**, **24** of the six container walls **19-24** for enclosing the inner volume **18**. This allows the cartridge **3** to be side loaded. The first shell **36** may comprise one integrally molded shape including one or more structures for fluidic interfaces, latching, keying, alignment, fitting, other assembly purposes, etc. In an embodiment of a method of assembly, the bag **25** may be placed in the first shell **36**. The bag **25** is positioned in the first shell **36** so that its opening **38** is connected to a channel **39** in the cartridge **3** (FIG. **8**). The bag **25** may be assembled in deflated condition. The bag **25** is positioned on a substantially planar part of the side wall **20** so that it lies in a substantially flat condition against the side wall **20**. The spring **26** may be placed on top of the bag **25**. The valve **32** may be placed on top of the third fluidic interface **33**. In the shown embodiment, the seal disk **34** is placed on top of the third fluidic interface **33** and the ball **35** is placed on top of the seal disk **34**. The lever **31** may be placed on top of the spring **26** and valve **32**. The second shell **37** may function as a side lid for placement against the first shell **36** in a final stage of assembly, for enclosing the inner volume **18**. The second shell **37** may comprise one **21** of the six container walls **19-24**. In the shown embodiment, the second shell **37** comprises one of the side walls **21**. The second shell **37** may function as a lid. The second shell **37** may be a closed shell, without fluid openings, for closing the inner volume **18** after the pressure regulation, pressure accumulation and priming features have been positioned in the inner volume **18**.

FIGS. **8** and **9** illustrate an embodiment of the cartridge **3** wherein a part of the first shell **36** is cut out for illustrative purposes. As shown, the bag **25** is provided with an opening

38 for letting the pressure fluid in and out of the bag **25**. The cartridge **3** comprises a channel **39** that has a fluidic connection with the opening **38** so that the pressure fluid may flow through the channel **39** and the opening **38**. On the other end, the channel **39** is in connection with an exterior of the cartridge, for example with ambient air and/or a pump, for example through the first cartridge fluidic interface **13**.

The channel **39** opens into the pressure bag **25**. For example, the channel **39** comprises a channel mouth **40** that opens into the inner volume **18**. The bag **25** is attached to the cartridge wall **20** so that the opening **38** and the channel mouth **40** overlap. In this way the pressure fluid may be transported between the bag **25** and the exterior of the fluid cartridge **3**.

In the shown embodiment, the channel **39** has a longitudinal, longitudinally extended shape, including one or more curves and having a relatively thin diameter. The channel **39** comprises a labyrinth. The channel **39** is arranged to reduce water vapor loss from the bag **25** while allowing gas to flow through. The total length of the channel **39** may be at least approximately 30, or at least approximately 40 times the diameter D of the channel, for example at least 30, or at least 40 times the average diameter D. However, in other embodiments the channel comprises a through opening through the respective cartridge wall **20**, for example having a much smaller length vs. diameter ratio.

The bag **25** is attached to the wall **20** in an attachment zone. The attachment zone is the bag and wall surface wherein the bag **25** is attached to the respective wall **20**. In the shown embodiment, an attachment feature **41** is provided for attaching the bag **25** to the wall **20**. The attachment feature **41** is arranged to attach the bag **25** to the wall **20**. The attachment feature **41** is relatively thin. The attachment feature **41** may be a separate feature between the bag **25** and the wall **20**, or may comprise a deformation or the like to attach the bag **25** and the wall **20**.

In the shown embodiments the attachment feature **41** comprises adhesive. Applying adhesive allows for relatively easy assembly of the bag **25** within the cartridge **3**. For example, the bag **25** may be adhered to the substantially planar bottom of the first shell **36**, in a flat condition, and with its opening **38** connected to the mouth **40** of the channel **39**.

In other embodiments, the attachment feature **41** may comprise a staked, welded, and/or heat sealed attachment. In the process of welding, staking and/or heat sealing the bag **25** and the wall **20** together, the parts **20**, **25** may locally melt and join. Multiple suitable welding techniques exist. One form of staking is heat staking, as known in the art.

A relatively thin attachment feature **41** may be provided, for relatively direct attachment to the planar side wall **20**, or at least the planar part thereof, aiding in an overall thinner shape of the bag **25** and the whole cartridge **3**. In a deflated condition, the substantially flat bag **25** may extend against the planar part of the side wall **20**, allowing for more space efficient use, and larger quantities of ejection fluid that may flow relatively freely in the cartridge **3**.

The bag **25** is attached to a substantially planar inner surface of the respective side wall **20**. The planar inner surface to which the bag **25** is attached is substantially parallel to the direction of insertion Ld of the cartridge **3**. The respective wall and bag **25** may be free from special arrangements for attaching the bag **25**, such as fitments. The bag **25** may be directly attached against the respective surface of the wall **20**, for example by adhesive, staking and/or welding, and may be deflated up to a substantially flat condition against said side wall **20**.

In FIG. **6** it can be seen that the bag **25** lies flat against the planar bottom of the first shell **36**. This may be made possible by the simple shape of the bag **25**. In one embodiment, the bag **25** is directly adhered to the side wall **20**, as explained above. In other embodiments, the bag **25** may be welded or staked to the side wall **20**. The attachment to the flat side wall **20** and the flat and simple shape of the bag **25** may allow for a thin attachment feature **41**. In certain embodiments the attachment feature **41** may comprise a thickness of 2 millimeter or less, or 1 millimeter or less, or 0.5 millimeter or less, or for example approximately 0 millimeter in case the bag **25** is welded or staked to the wall **20**. For example, the bag **25** may be attached to the side wall **20** by heat welding or staking.

It is noted that in prior art cartridges with a pressure bag, the attachment features used are fitments and/or special protrusions to attach to the bag to a cartridge wall. For example, during manufacture, first the fitment is attached to the bag, and then the bag is attached to the wall by attaching the fitment to the wall, or to a protrusion extending from the wall.

In contrast, the bag **25** of this disclosure can be attached directly to the flat surface of the side wall **20**, using relatively thin attachment features **41**, so that said fitments or protruding walls can be left out. The inner wall **20** has a substantially planar surface for attaching the bag **25**, instead of specially construed ribs or the like, allowing for a simpler construction. In turn, inner volume **18** is gained for containing relatively more ink within the cartridge **3**. The cartridge **3** is relatively thin. The bag **25** may have a relatively flat and simple shape because fitments for attaching the bag to the wall may be redundant due to the relatively simple attachment features **41** proposed in this disclosure. Furthermore, the side wall **20** may be relatively flat because of the direct attachment of the bag **25** by the attachment feature **41**, in turn made possible by the simple shape of the bag **25**. Moreover, as a result of the relatively flat shape of the bag **25** extending along the wall **20** to which it is attached, undesirable interaction between the second fluid and the attachment feature **41** may be prevented because the fluid is prevented from flowing between the bag **25** and the wall **20**.

In further embodiments, the bag **25** is attached to the side wall **20** by a combination of adhesive and one of a welding and staking feature. This may provide for a better attachment, for example in case of relatively aggressive inks.

An embodiment of an adhesive comprises PSA (Pressure Sensitive Adhesive). PSA bonds by applying pressure to it. The bag **25** can be attached relatively fast and easy by using the PSA. It also appeared that the PSA and ejection fluid may be relatively compatible. In an embodiment, the ejection fluid and the PSA do not negatively interact during an average lifetime of the cartridge **3**. Interaction between the PSA and the ejection fluid may be reduced because the flat surface **43** of the bag **25** extends along and at least partly engages the planar surface of the respective cartridge wall **20**. Multiple PSA embodiments are suitable. One example of a PSA comprises acrylic and rubber components. Non-PSA embodiments may also be suitable, such as certain Ultraviolet cured adhesives and/or Radiofrequency and/or microwave cared adhesives.

The bag **25** is attached to the wall **20** near and around the channel mouth **40**. The applied attachment feature **41** may be applied to form a ring shaped attachment zone, extending around the channel mouth **40** and opening **38**. By applying the attachment feature **41** around the mouth **40**, a substantially fluid tight connection may be maintained between the bag **25** and the wall **20**. In certain embodiments, the attachment zone extends exclusively near the channel mouth **40** and left away from a circumferential edge zone **44**. FIG. **9** illustrates an example of a circumferential edge zone **44** in a partly inflated and globed condition. The circumferential edge zone **44** extends along the circumferential bag edges **42**A-D. The circumferential edge zone **44** is the circumferential bag portion that at least partly globes when inflated.

By attaching the bag **25** to the wall **20** near the mouth **40** and/or opening **38**, ejection fluid may be kept away from the attachment zone, because little or no ejection fluid may flow between the bag film **45** that extends against or near the side wall **20**. By having the attachment zone away from the edges **42**A-D, it may be prevented that the bag **25** peels off during inflation, especially near the circumferential edge zone **44**, and when hyper-inflating. In an embodiment, by applying the adhesive near the mouth **40** and/or opening **38** the adhesive may be pressed against the wall **20** at inflation.

In one embodiment, the outer diameter d of the attachment zone, as formed by the attachment feature **41** (see FIG. **8**) is approximately 20 millimeter or less, or for example approximately 16 millimeter or less. In one embodiment the outer diameter d of the attachment feature **41** is approximately 13 millimeters for attaching a bag having a height or width of approximately 34 millimeter, wherein the height or width of the bag **25** is the distance between to opposite edges **42**A-D of the bag **25**. For example the outer diameter d of the attachment feature may be approximately 40% or less of the total height or width of the bag **25**.

The bag **25** may basically comprise two films **45**, **46** that are attached together near the circumferential edges **42**A-D. The films **45**, **46** may be staked together, for example heat staked, near the edges **42**A-D. One of the films **46** may have been provided with the opening **38** before attaching the films **45**, **46**. The staked bag **25** has a circumferential stake seam edge **49**. In another embodiment, the bag **25** is formed of one film **45** that is folded and then staked.

As illustrated by FIGS. **10**A and **10**B, to facilitate a relatively free flow of pressure fluid into and out of the bag **25**, the resilient element **26**A may comprise depressions **47**, **48** in the engagement surface **28** that in assembled condition extend near the opening **38** of the bag **25**, and the mouth **40** of the channel **39**. The depressions **47**, **48** may prevent that air remains in the bag **25** because the engagement surface **28** presses the films **45**, **46** together and blocks the opening **38**. This could occur when the bag **25** is largely or completely deflated. Other known bags are provided with particular internal bleed features that prevent such from happening. In this disclosure, an internal bleed feature need not be required because of the depressions **47**, **48**. The depressions **47**, **48** may comprise one, two, three or more relatively small dimples, close to the mouth **40**. In the shown embodiment, two dimples are provided extending relatively close to the mouth **40** to aid in free flow of pressure fluid to and out of the bag **25**.

FIG. **11** shows an embodiment of a method of manufacturing a fluid cartridge **3** by means of a flow chart. The steps of manufacturing and attaching a pressure bag **25** in the cartridge **3** are shown. In a step **100**, a film **45** is perforated so that an opening **38** is formed in the film **45** (FIG. **13**A). **45** The film **45** may be ribbon shaped. The films **45** may comprise plastic films, for example polypropylene, polyethylene, or another suitable relatively impermeable plastic. The film **45** is then used to form a bag **25**, as indicated by step **110**. For example, a second film **46** is attached to the first film **45** and the bag **25** is cut out. In an embodiment, the attachment feature **41** comprises a stake, weld or adhesive feature. In an embodiment, just one film is folded and the edges are closed off to form the bag **25**.

As indicated by step **120**, the attachment feature **41** is applied around the opening **38** or around the mouth **40** of the channel **39**. In one embodiment, adhesive is applied around the mouth **40**. In a further embodiment, the adhesive is applied around the opening **38**. In again another embodiment, adhesive is applied around both. In other embodiments, the bag **25** is staked or welded to the wall **20**.

The bag **25** is attached to a cartridge inner wall **20** wherein the bag film **45** extends parallel to the planar part of the inner wall **20**. The bag **25** is attached to the wall **20** so that the opening **38** is in open connection with the channel **39**. The attachment feature **41** attaches the bag **25** to the wall **20** around the mouth **40** of the channel **39**, as indicated by step **45**.

FIG. **12** shows a further embodiment of a method of manufacturing a fluid cartridge **3**, by means of a flow chart. FIG. **13**A-C schematically illustrates certain phases of the bag formation, corresponding flow chart of FIG. **12**. In a first step **200**, a film **45** is provided. The film **45** is perforated providing for an opening **38**. Another film **46** Is provided that may have approximately a similar size as the first film **46**. The two films **45**, **46** are positioned in parallel (see FIG. **13**A). In a next step **210**, the films **45**, **46** are staked (FIG. **13**B). The films **45**, **46** are staked to form circumferential edges **42** of the bag **25**. The staked seams **49** form a pocket **132** in the films **45**, **46**. In similar embodiments, the films **45**, **46** may be glued, sealed or welded together to form a pocket **132**. In a step **220**, the films **45**, **46** are cut around the staked seams **49**, forming the circumferential bag edge **42**, so that the bag **25** can be taken out of the films **45**, **46**. In an embodiment, the bag **25** may be staked and cut at the same time. As can be seen from FIG. **13**C, the pressure bags **25** may be ready to be placed in the cartridge **3**.

In step **230**, adhesive is provided around one of the opening **38** and the mouth of the channel **39**. For example, the adhesive is applied around the mouth **40**. In step **240**, the bag **25** is engaged with the wall **20** so that the opening **38** of the bag **25** and the mouth **40** of the channel **39** overlap. In this way, the inside of the bag **25** is in open communication with the channel **39**. In a step **250**, the adhesive is pressurized between the bag **25** and the wall **20**. For example, the bag **25** is pressed against the cartridge wall **20**. In an embodiment, the adhesive comprises PSA, and the PSA is pressurized until it bonds. The resulting PSA feature may be approximately 0.5 millimeters thick, or thinner. In a further embodiment, the adhesive is applied exclusively near and around at least one of the mouth **40** of the channel **39** and the opening **38**, and not near the circumferential edge zone **44** of the bag **25**.

In further steps, as already explained above with reference to FIGS. **6** and **7**, further parts, such as pressure regulating and accumulating parts, such as resilient elements **26** and valve parts, are assembled in the cartridge **3**.

The bag **25** may comprise more than two films **45**, **46**. FIG. **14** schematically shows an embodiment of a bag **25** with four films **45**, **133**, **134**, **46**. The bag **25** may have multiple stake seams **49**. In a further embodiment, one stake seam **49** is larger than another stake seam **49**, to facilitate easier staking. For example the bag **25** may comprise a bellows, to be inflated and deflated as a bellows. In one embodiment, the bag **25** comprises two or more bags **25**, of which one bag comprises two opposite openings **38** to transport pressure fluid between the other bag and the channel **39**.

The fluid cartridge **3** may be used for providing controlled quantities of fluid to a print head **4** or other type of ejector. In certain embodiments, the fluid may comprise a liquid or gas, to be connected to any type of fluid ejection device **1**, not necessarily a printer. For example, the fluid ejection device **1** may be any type of fluid dispense or administration device, wherein the fluid may for example be a pharmaceutical substance.

The bag **25** and manufacturing methods as explained above may facilitate smaller and thinner fluid cartridges **3** since fitments and ribs in the inner volume **18** of the cartridges **3** may be reduced. Leaving out fitments from the bag **25** may also provide longer spring **26** and bag **25** travel, and subsequently, better pressure control. Fuller inflation and deflation may be achieved within a relatively thin cartridge inner volume. This may be a step forward since conventionally thinner cartridge volumes used a foam type pressure mechanisms instead of pressure bag mechanisms.

Moreover, because of the simple bag shape and a reduction of fitments, the complexity and number of parts of the cartridges **3** may be reduced, thereby reducing costs of construction, shipment and storage. The bags **25** may be produced through planar films **45**, **46**, which would be difficult to achieve if fitments were attached. The adhesive may allow for simple and low cost installation of the bag **25**.

Certain embodiments of the bag **25** can be manufactured and installed at relatively low cost. Certain embodiments of the bag **25** showed to be suitable for hyper-inflation for performing a priming function. The bag **25** showed a good accumulator function, allowing easy expansion and contraction, at different temperature and pressure circumstances. While more complex prior art bags may show more hysteresis, the relatively simple bag shape and the planar attachment wall **20** presented in this disclosure may show little or no hysteresis, as compared to some prior art bags. Also, the simple bag construction provides a relatively wide range of options for the bag film material, so that a film **45** can be chosen that has a good compatibility with ink.

Furthermore, because the wall **20** and bag **25** are relatively flat, ejection fluid may be relatively free to slosh, which may prevent settling of the ejection fluid. The bag **25** may flatten substantially completely because of the simple shape of the bag **25** and the substantially planar surface of the wall **20** to which it is attached, facilitating efficient use of the inner volume **18**. The flat construction of the side wall **20** allows for the long, thin shaped channel **39** to extend within the side wall **20**.

In one aspect of the invention, a fluid cartridge **3** is provided, that may comprise an inner volume **18** for holding a fluid, defined by inner walls **19-24**, a pressure bag **25** in the inner volume **18**, for containing a pressure fluid, comprising a film **45**, **46**, and a channel **39** arranged in the cartridge wall **20**, comprising a channel mouth **40** opening into the pressure bag **25**, for transporting pressure fluid between the bag **25** and an exterior of the fluid cartridge **3**, wherein the bag film **45** is attached to a substantially planar inner wall **20**, around the channel mouth **40**, the attached bag film portion extending parallel to the inner wall **20**. In an embodiment, in a deflated condition of the pressure bag **25**, the bag **25** extends substantially parallel to a planar surface of said inner wall **20**. In an embodiment, the attachment feature **41** for attaching the bag **25** to said inner wall **20** has a thickness of approximately 2 millimeter or less, for example approximately 1 millimeter or less, or for example approximately 0.5 millimeter or less. In an embodiment, the bag **25** and said substantially planar inner wall **20** are attached along an attachment zone. This attachment zone may extend exclusively around the mouth **40** of the channel **36**, and not in a circumferential edge zone **44** of the bag **25**, which globes in an inflated condition of the bag **25**, so that tension in the attachment zone is prevented. In a further embodiment, the attachment feature **41** comprises adhesive, for example PSA (pressure sensitive adhesive). In again a further embodiment, a resilient element **26**A extends within the inner volume **18**. In an embodiment, the resilient element **26**A has a relatively flat engagement surface **28** that engages the pressure bag **25** for pressing the pressure bag **25** towards deflation, without being attached to the pressure bag **25**. In an embodiment, the cartridge **3** has a relatively thin outer shape with a length versus width ratio of at least approximately 4:1. In an embodiment, the fluid cartridge **3** is an ink cartridge for connection to an inkjet printer, the fluid in the inner volume **18** comprising ink, and the fluid in the pressure bag **25** comprising air.

In a further aspect, a method of manufacturing a fluid cartridge **3** is provided. The method may comprise perforating a film **45** to form an opening **38**, forming a bag **25** with said film **45**, and attaching the bag film **45** to a substantially planar inner wall **20**, parallel to the substantially planar inner wall **20**, so that the opening **38** is in open connection with a fluid channel **39** in the wall **20** and the bag film **45** is attached to the wall **20** around the opening **38**. In an embodiment, the method comprises attaching the bag **25** exclusively near and around at least one of the mouth **40** of the channel **39** and the opening **38**, and not in a circumferential edge zone **44** of the bag **25** that globes in an inflated condition of the bag **25**, so that tension in an attachment zone **41** is prevented. In a further embodiment, the method comprises attaching the bag **25** to the wall **20** by an attachment feature **41** having a thickness of 2 millimeters or less, for example by adhesive such as PSA. In again a further embodiment, the forming of the bag **25** comprises providing at least two films **45**, **46** parallel to each other, wherein one film **45** comprises an opening **38**, staking a circumferential edge **42**, **49** in the films **45**, **46** so as to form a pocket **132** between the films **45**, **46**, and cutting the pocket **132** out of the films **45**, **46**, around the staked edge **42**, **49**.

In again a further aspect, a fluid cartridge may be provided, comprising inner walls **19-24**, forming an inner volume **18** for ejection fluid, a pressure bag **25** extending in the inner volume **18**, attached to one of the inner walls **19-24**, the pressure bag **25** being attached so that in a deflated condition the bag **25** is relatively flat and extends with its flat side surface **43** against, and parallel to, a planar part of the inner wall **20** to which it is attached.

The above description is not intended to be exhaustive or to limit the invention to the embodiments disclosed. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. The indefinite article "a" or "an" does not exclude a plurality, while a reference to a certain number of elements does not exclude the possibility of having more elements. A single unit may fulfil the functions of several items recited in the disclosure, and vice versa several items may fulfil the function of one unit.

In the following claims, the mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Multiple alternatives, equivalents, variations and combinations may be made without departing from the scope of the invention.

The invention claimed is:

1. A fluid cartridge, comprising

an inner volume for holding a fluid, the inner volume defined by inner walls,

a pressure bag in the inner volume for containing a pressure fluid, the pressure bag comprising at least two films, the at least two films being staked around a circumferential edge to form a pocket between the at least two films, and a channel arranged in an inner wall of the cartridge, comprising a channel mouth for transporting pressure fluid between the pressure bag and an exterior of the fluid cartridge,

wherein the pressure bag is attached to the inner wall around the channel mouth, the pressure bag comprising an opening defined therein,

wherein the pressure bag and said inner wall are directly attached along an attachment zone radially surrounding the opening, the attachment zone extending exclusively around the mouth of the channel, and not to a circumferential edge of the bag.

2. The fluid cartridge according to claim **1**, wherein the attachment zone comprises a thickness of 2 millimeters or less.

3. The fluid cartridge according to claim **1**, wherein the attachment zone does not extend in the circumferential edge of the bag that globes in an inflated condition of the bag, so that tension in the attachment zone is prevented.

4. The fluid cartridge according to claim **1**, comprising a resilient element extending within the inner volume, having a relatively flat engagement surface that engages the pressure bag for pressing the pressure bag towards deflation, without being attached to the pressure bag.

5. The fluid cartridge according to claim **1**, having a relatively thin outer shape with a length versus width ratio of at least 4:1.

6. The fluid cartridge according to claim **1**, the fluid cartridge forming an ink cartridge for connection to an inkjet printer, the fluid in the inner volume comprising ink, and the fluid in the pressure bag comprising air.

7. A fluid cartridge according to claim **1**, wherein said channel extends through and within said cartridge wall to a fluidic interface on a front portion of said fluid cartridge, said front portion of the fluid cartridge also comprising a fluidic interface from which the fluid from said inner volume is discharged from the fluid cartridge during printing operations.

8. The fluid cartridge of claim **1**, in which a portion of the pressure bag does not enter the channel.

9. The fluid cartridge according to claim **1**, wherein the bag is attached to the wall by adhesive.

10. The fluid cartridge according to claim **9**, wherein the adhesive comprises pressure sensitive adhesive.

11. A fluid cartridge according to claim **1**, further comprising:

a valve controlling a fluidic interface for allowing a fluid into the inner volume,

wherein the valve is operated by the pressure bag as the pressure bag inflates and deflates.

12. A fluid cartridge according to claim **11**, further comprising a lever connected to said valve, wherein said lever is engaged by and moved by inflation of said pressure bag so as to actuate said valve.

13. A method of manufacturing a fluid cartridge, comprising:

providing at least two films,

perforating one of said films to form an opening,

forming a bag with said films by staking the two films together around a circumferential edge so as to form a pocket between the films, and

attaching a first one of the films of said bag having said opening to a substantially planar inner wall of said fluid cartridge, so that the opening is in open connection with a fluid channel in the inner wall and the film of the bag is attached to the inner wall around the opening,

in which the first film and said inner wall are directly attached along an attachment zone, the attachment zone extending exclusively around the mouth of the channel, and not in the circumferential edge of the bag, so that tension in the attachment zone is prevented.

14. The method according to claim **13**, wherein the attachment zones comprises a thickness of 2 millimeters or less.

15. The method according to claim **13**, the forming of the bag further comprising cutting the pocket out of the films, around the staked circumferential edge.

16. The method according to claim **13**, comprising attaching the bag to the inner wall by adhesive.

17. The method according to claim **16**, wherein the adhesive is a pressure sensitive adhesive, comprising pressurizing the adhesive between the film and the inner wall.

18. A fluid cartridge, comprising

inner walls forming an inner volume for containing an ejection fluid,

a pressure bag extending in the inner volume attached to a first one of the inner walls, the pressure bag comprising at least two films, the at least two films being staked around a circumferential edge to form a pocket between the at least two films, in which the pressure bag is attached so that in a deflated condition the pressure bag is relatively flat and extends with its flat side surface against, and parallel to, a planar part of the first inner wall to which it is attached, and

a channel defined in the first inner wall comprising a channel mouth opening into the pressure bag via an opening defined in the pressure bag, for transporting pressure fluid between the pressure bag and an exterior of the fluid cartridge,

wherein the pressure bag and first inner wall are directly attached along an attachment zone radially surrounding the opening, the attachment zone extending exclusively around the channel mouth, and not to the circumferential edge of the pressure bag that globes in an inflated condition of the bag.

19. A fluid cartridge according to claim **18**, further comprising:

a valve controlling a fluidic interface for allowing a pressure fluid into the inner volume, the valve operating by the pressure bag as the pressure bag inflates and deflates;

a lever connected to said valve, wherein said lever is engaged by and moved by inflation of said pressure bag so as to actuate said valve.

20. A fluid cartridge according to claim **18**, wherein the channel has a longitudinal shape and comprises at least one curve along its length so as to reduce water vapor loss from inside the pressure bag.

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